

REMARKS

Entry of the foregoing, re-examination and reconsideration of the subject matter identified in caption, as amended, pursuant to and consistent with 37 C.F.R. § 1.111, and in light of the remarks which follow, are respectfully requested.

Claims 1 and 16 have been amended to incorporate the subject matter of claims 2 and 21, respectively, and claims 2 and 21 have been cancelled, accordingly. Further, claims 1 and 16 have been amended to explicitly recite "from a gaseous natural gas feed stream." These amendments are supported throughout the specification. Claims 1 and 16 have also been amended to further improve their form. Upon entry of the Amendment, claims 1, 3-20 and 22-54 will be all the claims pending in the application.

Applicants note with appreciation that claims 35-54 are allowed.

I. Response to Rejections Under 35 U.S.C. § 102

a. Claims 1, 3, 5 and 13-15 were rejected under 35 U.S.C. § 102(b) as being anticipated by Dickey et al. (U.S. Patent No. 3,376,709).

Applicants respectfully submit that the claims as amended are novel over Dickey et al. Claims 3-5 and 13-15 depend from claim 1, directly or indirectly. As noted above, claim 1 has been amended to incorporate the subject matter of claim 2, which is not included in the rejection.

Moreover, while Dickey et al. may disclose a system for removing carbon dioxide from natural gas by expanding a natural gas stream to form a slurry of carbon dioxide particles in liquefied natural gas, this process is clearly different from the processes defined in the present claims.

Specifically, Dickey et al. describes providing a single liquid phase of natural gas and sour species in which the sour species are present as a liquid solution in the liquefied natural gas (see column 2, lines 32 to 38). The single phase liquid is then expanded to a low pressure and decreased temperature at which solid, liquid and vapor phases form and co-exist. The expansion step is carried out so that the three resultant phases are immediately passed into a body of an existing slurry of liquefied natural gas and solid particles of sour species, with the solid particles constituting nucleation sites to encourage growth of large crystals or agglomerates of the solid species, thereby improving solid-liquid separation of the species so formed (see column 2, lines 38 to 63). According to Dickey et al., introducing the three-phase mixture from below the surface of the slurry also has the effects of scrubbing the natural gas vapor and removing any solid particles of sour species entrained in the vapor phase (column 2, line 64 to column 3, line 1).

In contrast, claims 1-34 provide a gaseous stream (not a liquid stream, as is the case in Dickey et al.) and cools the feed stream in a cooling vessel (not immediately beforehand, as is the case in Dickey et al.). Moreover, in an embodiment of the present invention, cooling of the gaseous stream may be conducted by isotropically expanding the gaseous stream and/or introducing a stream of sub-cooled LNG, all conducted within the cooling vessel and not immediately beforehand. Further, the cooled gas stream is introduced into a void of the cooling vessel and not below the surface of an LNG slurry containing solid carbon dioxide particles.

Additionally, Dickey et al. is silent on maintaining a temperature gradient within the cooling vessel. In fact, the body of the existing slurry within the cooling vessel described in Dickey et al. is believed to inherently provide a constant temperature throughout.

In view of the foregoing, Applicants respectfully submit that the claims are not anticipated by Dickey et al. and thus the rejection should be withdrawn.

b. Claims 1, 3, 4, 13, 14, 16, 17, 22, 23, 32 and 33 were rejected under 35 U.S.C. § 102(e) as being anticipated by Wilding et al. (U.S. Patent No. 6,581,409).

Applicants respectfully submit that the claims as amended are novel over Wilding et al. Claims 3, 4, 13 and 14 depend from claim 1, directly or indirectly. Further, claims 17, 22, 23, 32 and 33 depend from claim 16, directly or indirectly. As noted above, claims 1 and 16 have been amended to incorporate the subject matter of claims 2 and 21, respectively, which are not included in the rejection. Accordingly, the Examiner is respectfully requested to reconsider and withdraw the rejection.

II. Response to Rejections Under 35 U.S.C. § 103

a. Claims 2, 8-12, 21, 30 and 27-31 were rejected under 35 U.S.C. § 103(a) as being unpatentable over either Wilding et al. or Dickey et al. in view of Strong et al. (U.S. Patent No. 5,715,702).

Applicants respectfully submit that the claims as amended are patentable over the cited references for at least the following reasons.

As noted above, independent claims 1 and 16 have been amended to incorporate the subject matter of claims 2 and 21, respectively, and claims 2 and 21 have been canceled. Regarding claim 2, it was asserted that "Applicants state in the specification that stirring the fluid forms a colder temperature at the center of the cooling chamber."

Applicants respectfully disagree, because nowhere in the specification do Applicants make the above statement. Rather, Applicants continuously affirm the importance of

maintaining a temperature gradient within the cooling vessel such that the temperature towards the center of the cooling vessel is less than the temperature at the wall of the cooling vessel. As described on page 3, lines 30 to 33 of the specification, "one way of achieving this is to use a material of construction for at least the internal wall of the cooling vessel surrounding the solidification zone from a material having a low thermal conductivity." The construction details and considerations are also provided at greater length on page 6, lines 8 to 25; page 9, line 34; page 10, line 10; and page 16, lines 8 to 16.

Stirring can create a vortex, which alone, however, does not result in a colder temperature at the center of the cooling chamber, contrary to the Examiner's assertion. Rather, the benefits of creating a vortex are that it can assist in accumulating solids of the freezable species towards the center of the cooling vessel as well as encourage the migration of solids under gravity towards the outlet of the cooling vessel. In this regard, Applicants describe that in the absence of a vortex in the vessel, a very low percentage of solids were observed to form on the walls of the cooling vessel, but readily detach from the walls due to thermocapillary motion of the fluid itself within the cooling vessel (see page 17, lines 25 to 32).

In view of the above, Applicants respectfully submit that Strong et al. does not rectify the deficiencies of Dickey et al. and Wilding et al. Therefore, even if, *arguendo*, that there might be motivation to combine Strong et al. with Dickey et al. or Wilding et al., the combination still would not result in the present invention.

Turning to claims 12 and 31, it was asserted that "Dickey et al. shows the recycling of separated liquid within the cooling chamber."

Applicants again respectfully disagree. In fact, Dickey et al. describes recycling slurry material (see column 6, lines 5 to 20), not liquefied natural gas, from the settling tank

where the average particle size of the majority of the solid acid gas particles are from about 0.001 μm to about 2 μm . The purpose of recycling the slurry is not to cool the phase mixture introduced into the vessel, but to "top up" the body of the slurry and to balance the withdrawal of slurry from the vessel, as well as to maintain and control the number and size of nucleation sites (i.e., solid acid gas particles) in the slurry to provide optimum crystal growth and separation of solid acid gas particles in the main body of the slurry. For these reasons, Applicants respectfully traverse the rejection of claims 12 and 31, additionally.

In view of the above, the Examiner is respectfully requested to reconsider and withdraw the rejection.

b. Claims 6, 7, 18, 19, 20, 24-26 and 34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Wilding et al. in view of Engdahl et al (U.S. Patent No. 5,819,555).

Applicants respectfully submit that the claims as amended are patentable over the cited references. Claims 6 and 7 depend from claim 1, directly or indirectly. Claims 18-20, 24-26 and 34 depend from claim 16, directly or indirectly. As noted above, claims 1 and 16 have been amended to incorporate the subject matter of claims 2 and 21, respectively, which are not included in the rejection. Accordingly, the Examiner is respectfully requested to reconsider and withdraw the rejection.

III. Conclusion

From the foregoing, further and favorable action in the form of a Notice of Allowance is believed to be next in order and such action is earnestly solicited. If there are any

questions concerning this paper or the application in general, the Examiner is invited to telephone the undersigned at (202) 452-7932 at his earliest convenience.

Respectfully submitted,

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Date: June 6, 2007

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